

THE WEATHER AND CIRCULATION OF OCTOBER 1967

Continued Cool East of the Rockies and Warm in the Far West

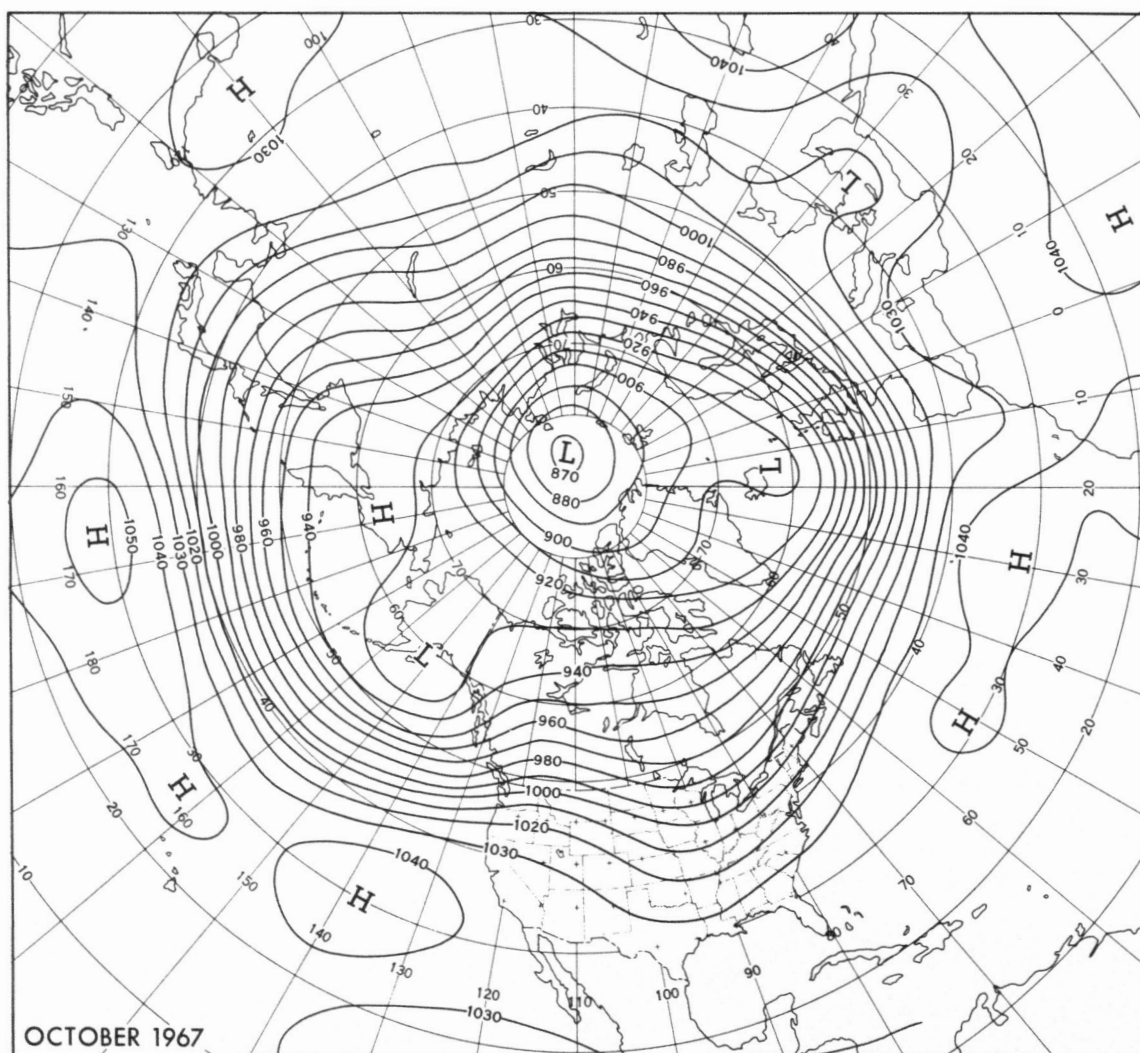
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1. MEAN CIRCULATION

The mean 700-mb. circulation for October 1967 was characterized by fast westerly flow and long waves of small amplitude (figs. 1 and 2). The zonal index, a measure of the strength of the middle-latitude westerlies over the western half of the Northern Hemisphere, was 11.8 meters per second, or 1.8 m.p.s. above normal. Mean 700-mb.

isotachs for the month also show the strong zonal character of the circulation, as indicated by the well-defined axis of maximum west wind in figure 3. This jet axis was close to normal over much of the Hemisphere, but was south of normal across North America and north of normal over Asia. Fastest wind speeds were 10 m.p.s. above normal over western Europe and the eastern half of the Pacific.



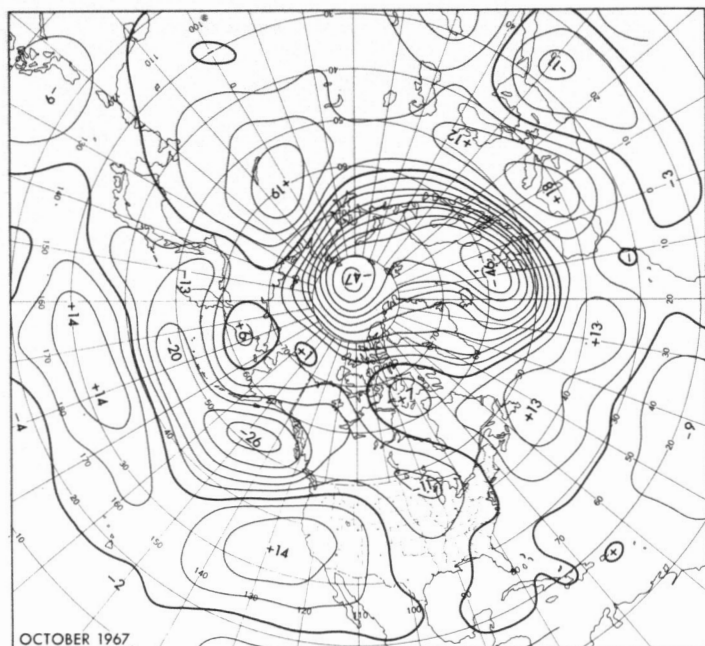


FIGURE 2.—Departure of mean 700-mb. height from normal (tens of feet) for October 1967.

October's circulation in the Pacific was similar to that of September [1]. The principal difference was in the intensity of the Gulf of Alaska Low. Heights here were only 260 ft. below normal in October compared with a record negative anomaly of 610 ft. in September. In addition, the trough in the southwestern Pacific in October was much weaker and west of its September position, a reflection primarily of less tropical activity in October.

Over North America the circulation consisted of a ridge over the West and a trough in the East (fig. 1). The ridge was stronger than normal in the United States, except near the Canadian border, and weaker than normal in Canada (fig. 2). This distribution of 700-mb. height anomaly contributed to faster than normal westerlies across the northern United States. Weak blocking prevailed in eastern Canada, as suggested by the +70-ft. anomaly center in figure 2.

An extensive band of positive height anomaly prevailed at middle latitudes across the Atlantic and Asia. To the north, and on the Asiatic side of the Pole, a deep Low was observed. A second Low was centered near Iceland, in association with a trough over the eastern Atlantic. These centers of action were the most anomalous features of the mean circulation and were associated with cool, stormy weather over northern Europe during October. Southern Europe, where 700-mb. heights were above normal and the flow was anticyclonic, enjoyed mostly warm and dry conditions.

2. TEMPERATURE

The outstanding feature of the temperature anomaly in October (fig. 4) was that it prolonged a pattern that has persisted since May 1967. Since then the general pattern

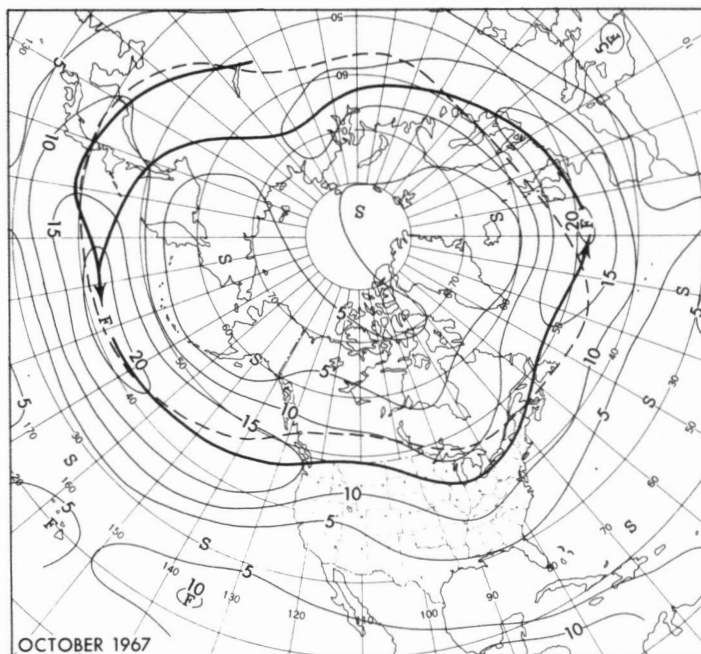


FIGURE 3.—Mean 700-mb. isotachs (meters per second) for October 1967. Solid arrows indicate principal axes of maximum wind speed and dashed line the October normal.

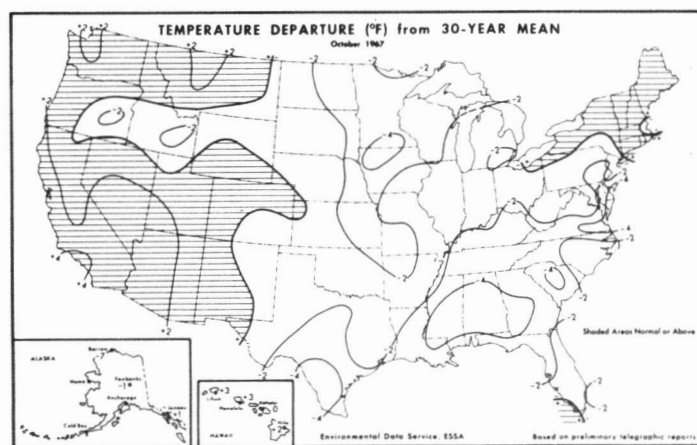


FIGURE 4.—Departure from normal of average surface temperature (°F.) for October 1967 (from [2]).

has consisted of above normal temperatures in the Far West and below normal in the East. October was notable, when compared with other months in the period, because of the small area of extreme temperature ("much above" and "much below").

Persistence of temperature has been unusually high in the Southeast where some cities have had monthly mean temperatures "much below" normal since May. In addition to observing 6 consecutive months of below normal temperature at Jackson, Miss., May through October was the coldest such period of record. Other cities having 6 consecutive months of below normal temperature were Birmingham, Ala., Macon, Ga., and Greenville-Spartanburg, S.C. By contrast, San Francisco, Calif., had its

warmest October in a 97-yr. record, and Helena, Mont., its fifth consecutive month of above normal temperature.

Monthly mean anomaly charts of 700-mb. height (fig. 2) and temperature (fig. 4) were typically related, with anomaly areas of the same sign corresponding quite well. Much of the coolness in the eastern two-thirds of the Nation was associated with anticyclones moving southeastward from the Pacific Northwest. In addition, cold Canadian air was tapped occasionally as the western ridge joined a ridge over Hudson Bay. Warmth in the West was related to the stronger than normal ridge. Along the southern California coast temperatures averaged as much as 5°F. above normal as Santa Ana wind conditions prevailed at times, and suggested by the strong northeasterly monthly mean anomalous flow (fig. 2). Above normal sea surface temperatures may have contributed to above normal temperatures in coastal areas of Washington where upper heights were below normal.

3. PRECIPITATION

Precipitation and components of the mean circulation in October were quite well related. Exceptionally wet weather prevailed in the Midwest in connection with the deeper than normal trough which extended from the Great Lakes to the Southern Plains (figs. 1, 2). Record and near record totals for October were reported from some areas as amounts were more than twice normal (fig. 5). At Dubuque, Iowa, the total fall was 8.58 in., more than three times normal and an October record. Marquette, Mich., had its second wettest October in an 80-yr. record, with other cities such as Indianapolis and Evansville, Ind., Topeka, Kans., and Kansas City, Mo., also reporting near record amounts. Developing storms moved from the Southern Plains to the Great Lakes and brought much of this precipitation. Cold fronts from these Lows spread precipitation across the Gulf Coast States where amounts were generally slightly above normal.

Because the principal storm track was west of the Appalachians, areas to the east were generally dry in October. In many places amounts were less than half normal. This was the driest October of record at Orlando, Fla., and the second driest at Daytona Beach; amounts at both cities were less than 10 percent of normal. Florida precipitation was one of marked contrast. In the western Panhandle, monthly amounts were as much as twice normal, but nearly all of this fell on the last 2 days of the month in connection with severe local storm activity. Precipitation from showers in the extreme southern part of the state was more evenly distributed, with amounts above normal along the southeast coast.

In the Northwest, storms associated with southwesterly upper flow brought heavy precipitation to the western portions of Washington and Oregon. Stampede Pass, Wash., reported 23.55 in., which was 14.74 in. above normal, a record for October. Immediately east

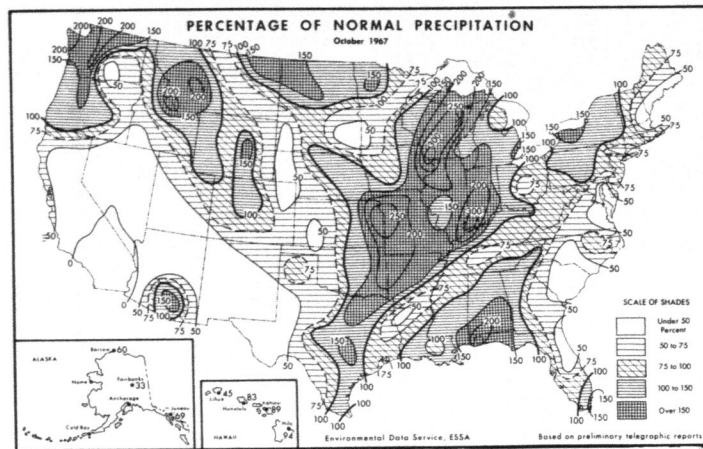


FIGURE 5.—Percentage of normal precipitation for October 1967 (from [2]).

of the Cascades moisture was deficient. At Pendleton, Oreg., October was the ninth consecutive month of sub-normal rainfall.

Storms from the Pacific were also responsible for much of the precipitation in the Northern and Central Plains States. In Montana and North Dakota amounts were mostly heavier than normal, while to the south subnormal amounts prevailed. Sioux Falls, S. Dak., reported its sixth consecutive month of below normal precipitation.

Except for locally heavy shower activity in south-central Arizona early in the month, the Southwest was very dry. Dryness here was in response to the ridge over the area with its above normal 700-mb. heights and northerly anomalous flow. This was the first rainless October since 1954 at San Diego, Calif., which also had 85 percent of possible sunshine, the highest of record (since 1890).

4. WEEKLY WEATHER AND CIRCULATION

Weekly patterns of temperature anomaly and total precipitation, along with the appropriate 700-mb. mean circulations are shown in figures 6 through 9. The circulation patterns indicate that the flow across the United States during the first week was not representative of the entire month. At that time a strong ridge was observed over the East and the wavelength was excessive between troughs in the eastern Pacific and western Atlantic (fig. 6A).

Cool Pacific air dominated much of the Far West (fig. 6B) and upper heights were below normal. Elsewhere over the Nation, except for the Southeast and northern border States, temperatures averaged above normal. Readings of 90°F. or higher were common in the Central Plains on the 3d with Goodland, Kans., reporting 93°F., a record for that date. Other cities with record high temperatures on the 3d were Cheyenne, Wyo. (83°F.), Denver, Colo. (87°F.), and Rochester, Minn. (83°F.). Warm weather spread eastward and on the 5th, Washington, D.C., had 91°F. and Richmond, Va., 90°F. A cold front advanced

through the Northeast late in the week. This ended the unusual warmth and spread freezing temperatures to interior sections of New England and New York State. The Southeast continued cool as the high pressure cell that moved into the area at the end of September remained nearly stationary for most of the week.

The predominantly southwest flow, which brought mild conditions to most areas during the first week, also brought precipitation to much of the Nation (fig. 6C). Heaviest amounts were along the northern Pacific Coast, Central Plains, and southern Florida.

A rapid readjustment occurred in the circulation from the first to the second week in response to the unusually long wavelength. This resulted as the area of weak cyclonic curvature over the Upper Great Plains (fig. 6A) developed into a deep trough over the East (fig. 7A). At the same time the ridge in the East and the trough in the western Atlantic progressed. A well-defined ridge also appeared over western North America as the principal center of cyclonic activity in the Pacific developed over the eastern Aleutians and replaced the ridge of the previous week.

Weather changes in the United States were compatible with the change in circulation. The East cooled considerably in the trough with mean temperature changes as much as 9°F. in the Ohio Valley (figs. 6B, 7B). An opposite change occurred in the Far West as mild weather replaced cool conditions of the previous week. The West also became drier beneath the ridge with most of the Southwest having no measurable precipitation (fig. 7C). The circulation and temperature patterns of the second week bore a marked similarity to those for the month (compare figures 1 and 6A, with figures 4 and 6B).

During the third week the deep cold trough remained over the East while the ridge over the West became stronger (fig. 8A). No significant change occurred in temperature, although parts of the Far West warmed slightly (fig. 8B). This was especially true along the southern California coast where strong Santa Ana winds, in association with the upper High over the Southwest, caused temperatures to average 10°F. above normal at Los Angeles. As the western High strengthened, the area of no precipitation expanded northward and eastward during the third week (fig. 8C).

From the third to the fourth week (figs. 8A, 9A), middle-latitude long-wave features over and adjacent to the United States retrograded approximately 10° long. Over Canada, however, progression occurred as the deep sub-polar Low moved to Davis Strait and weakened, then was replaced by a portion of the western ridge. The ridge, and its associated center of positive height anomaly, created moderate blocking. At sea level, the eastward movement of storms across Canada was slower in the fourth week, another manifestation of blocking. Blocking may also have contributed to retrogression of the trough in the eastern United States and also to a southward

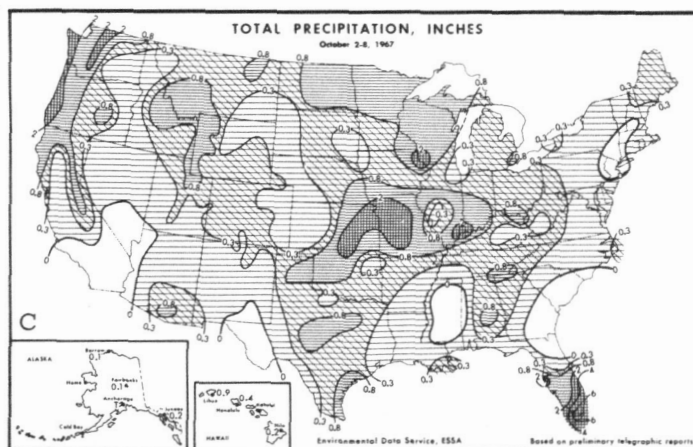
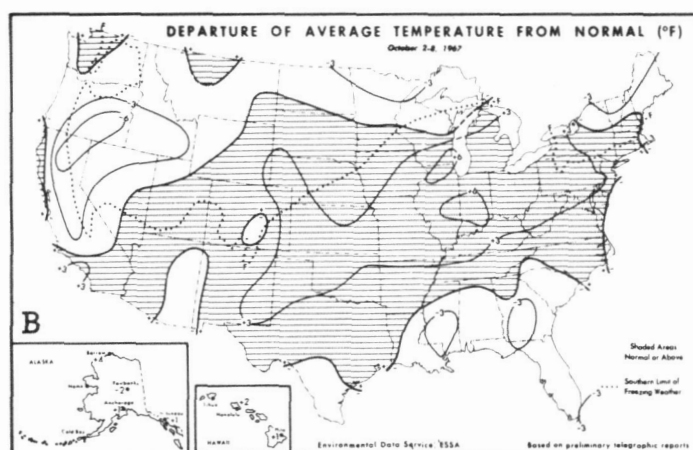
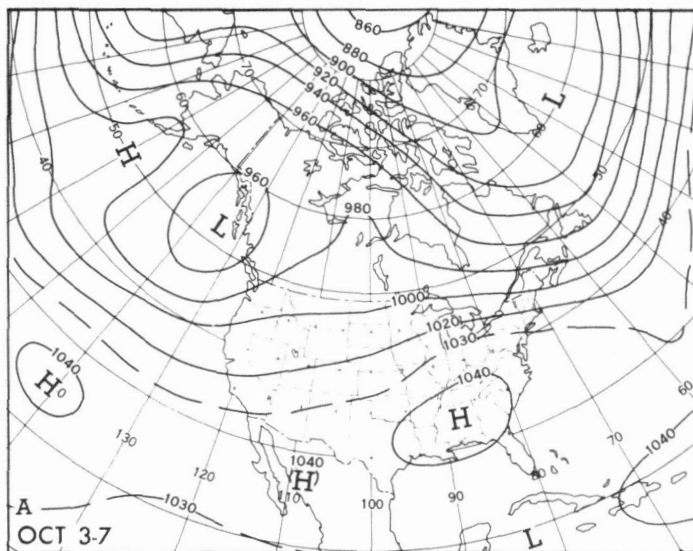


FIGURE 6.—Week of October 2-8, 1967: (A) 700-mb. contours (tens of feet), October 3-7; (B) surface temperature departure from normal (°F.); (C) total precipitation (in.); (B) and (C) from [2].

displacement of the westerlies in the Pacific Northwest. The latter is suggested by the change in and distribution of 700-mb. height anomaly (not shown).

Retrogression over the United States and deepening of the trough in the Great Lakes brought colder weather

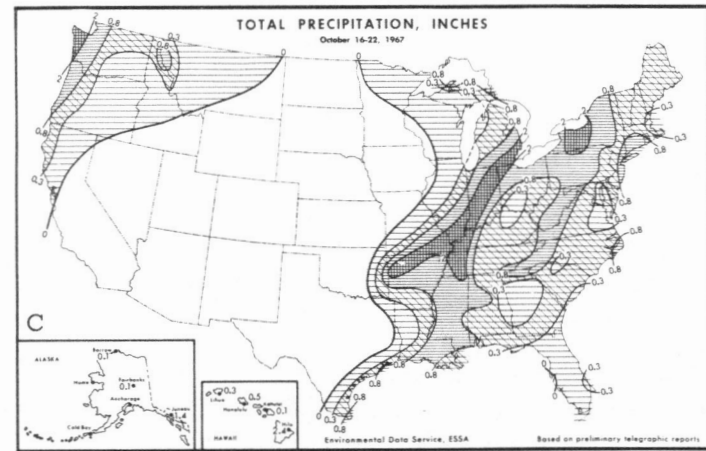
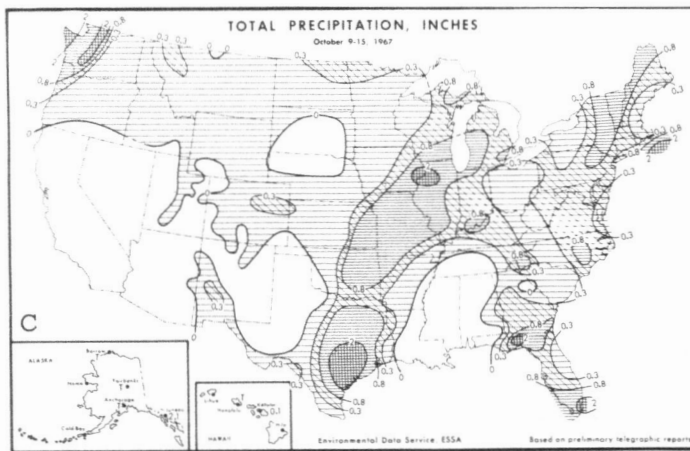
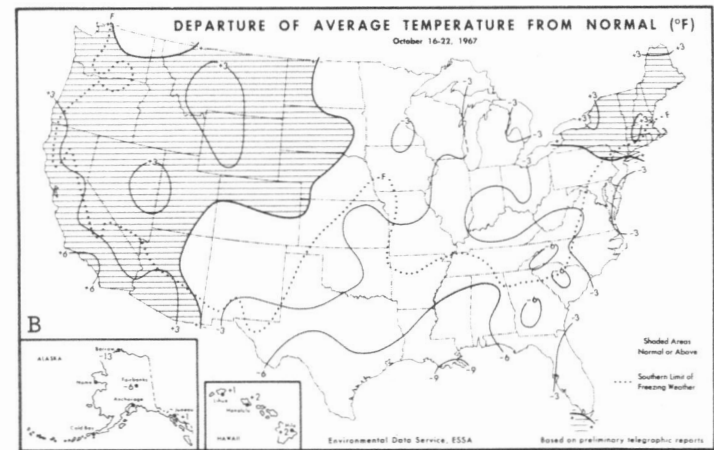
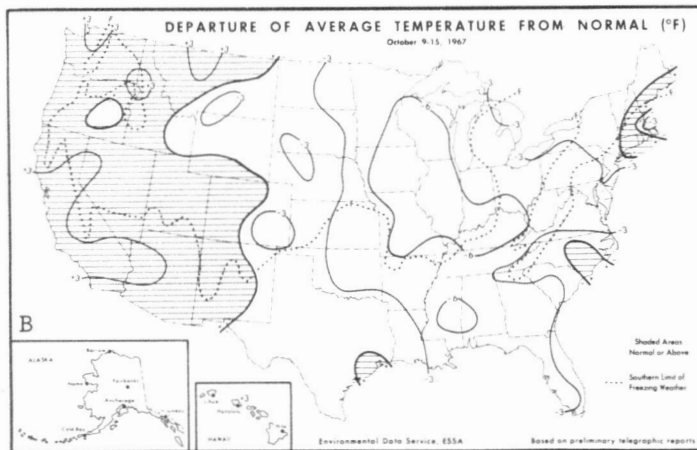
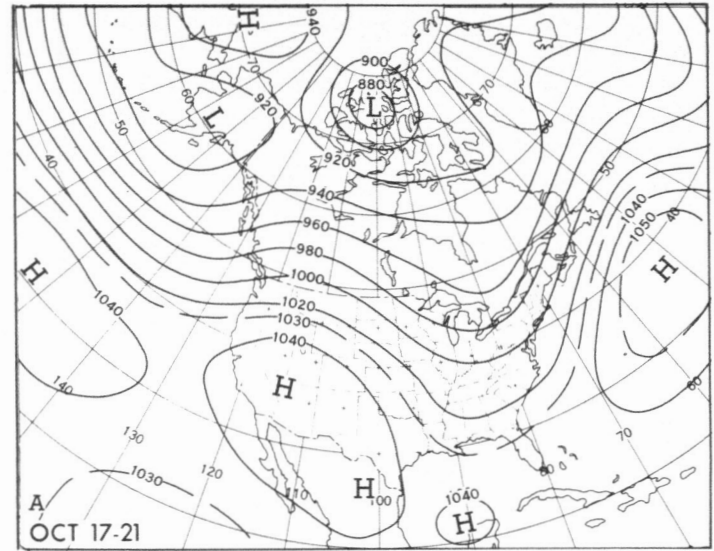
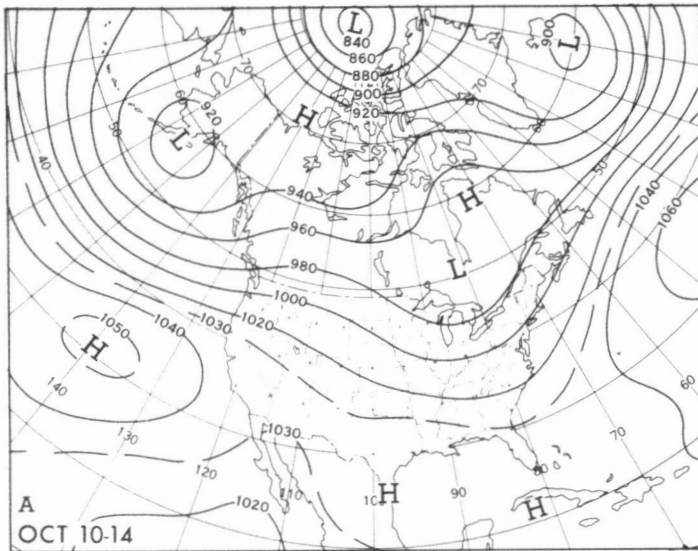


FIGURE 7.—Week of October 9–15, 1967: (A) 700-mb. contours (tens of feet), October 10–14; (B) and (C) same as figure 6.

FIGURE 8.—Week of October 16–22, 1967: (A) 700-mb. contours (tens of feet), October 17–21; (B) and (C) same as figure 6.

to the West, except in the Southwest where temperatures continued above normal (fig. 9B). Greatest changes were in the northern half of the Great Plains where temperature anomalies lowered about 6°F. from the third to fourth week. For the third consecutive week temperatures remained below normal in much of the eastern half of the Nation.

Some of the most severe weather of October occurred near the end of the month. Tornadoes struck the Midwest and Central Gulf States on the 24th and 25th in connection with a strong cold front. On the 26th and 27th a storm moved northeastward from the Southern Plains and brought the first major snowfall of the season to the Great Lakes Region and mid-Mississippi Valley. Maxi-

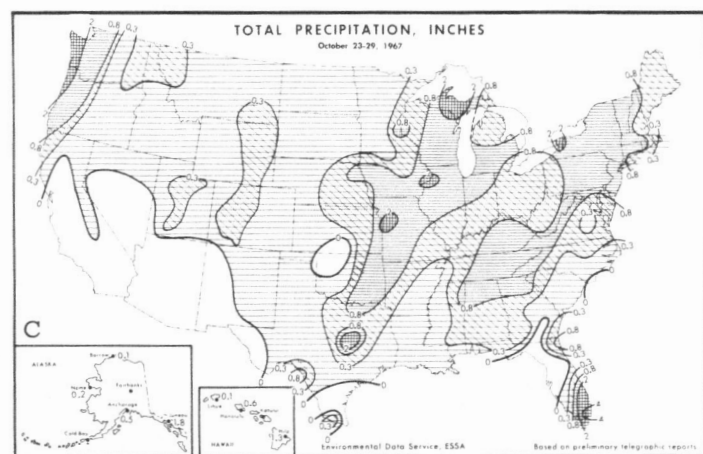
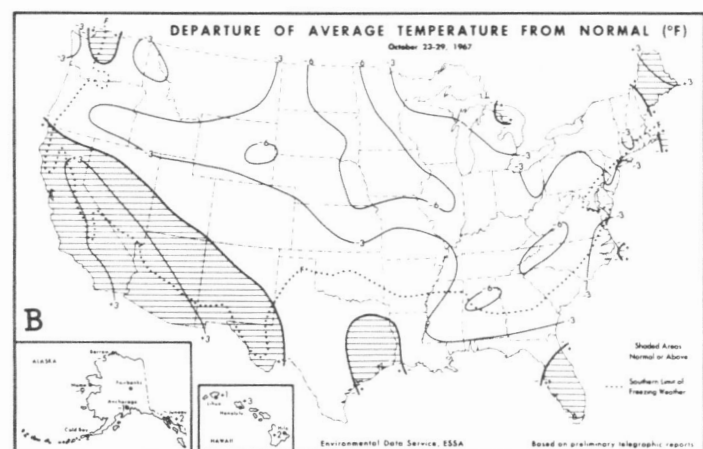
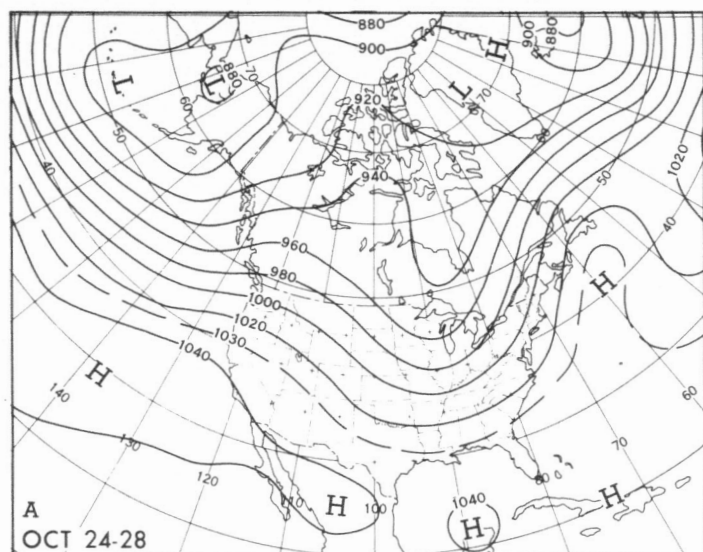


FIGURE 9.—Week of October 23-29, 1967: (A) 700-mb. contours (tens of feet), October 24-28; (B) and (C) same as figure 6.

mum snow depth was 18 in. at Ironwood, Mich. Several cities in Michigan reported record 24-hr. and monthly totals for any October. These included Grand Rapids (8.4 in.), Lansing (7.5 in.), and Muskegon (4.9 in.). In Illinois, Moline reported 6.6 in., also an October record.

A vigorous cold front spread severe storms, accompanied by heavy rains, from Louisiana to the Florida Panhandle on the 30th and 31st. Tornadoes in the Gulfport area of Mississippi killed three persons, injured scores, and caused property damage of several million dollars.

5. TROPICAL STORMS

The 1967 hurricane season in the North Atlantic was the first in which as many as eight tropical storms were observed when the first storm (Arlene) formed as late as August 28. There were three storms here in October, as shown in table 1 which summarizes tropical storm activity for the Atlantic and Pacific Oceans. Small hurricane Fern, first located by satellite APT photos on the 1st, developed to hurricane strength on the 2d in the southwest Gulf of Mexico. This storm moved inland over the northeast Mexican coast on the 4th, with 75-m.p.h. winds and heavy rains over a small area. Tropical storm Ginger formed near the African coast and, after drifting slowly westward for a few days, dissipated. Heidi, the eighth tropical storm of the season, formed near Bermuda after being tracked for several days as a depression. The storm reached hurricane force on the 23d, then moved on an easterly course to the vicinity of 38°N., 45°W., by the 26th where it remained nearly stationary until the 30th. Thereafter, Heidi weakened rapidly and moved northeastward.

The three storms in the eastern Pacific brought the total observed this season to 18, a record since 1949. The previous high was 13 and the average number for this period was nine. Recent increases may result from the use of meteorological satellites in an oceanic area where observations are sparse. None of the October storms posed any serious threat to land, but storm Olivia did pass over southern Baja California on the 14th before dissipating.

Typhoons Carla and Dinah in the western Pacific were the only storms to cause major damage to land areas. Carla passed over the northern Philippines on the 17th-18th before weakening in the South China Sea, while Dinah moved northeastward over Japan on the 27th-28th.

TABLE 1.—Summary of tropical storms for October 1967

	Name	Classification	Dates
North Atlantic	Fern.....	Hurricane.....	Oct. 1-4
	Ginger.....	Tropical Storm.....	Oct. 5-8
	Heidi.....	Hurricane.....	Oct. 19-Nov. 1
PACIFIC Eastern	Olivia.....	Tropical Storm.....	Oct. 6-14
	Priscilla.....	Hurricane.....	Oct. 14-21
	Ramona.....	Tropical Storm.....	Oct. 21-Nov. 3
PACIFIC Western	Amy.....	Typhoon.....	Sept. 29-Oct. 6
	Babe.....	Tropical Storm.....	Oct. 8-9
	Carla.....	Typhoon.....	Oct. 12-20
	Dinah.....	Typhoon.....	Oct. 17-28
	Emma.....	Typhoon.....	Oct. 31-Nov. 6

REFERENCES

1. A. J. Wagner, "The Weather and Circulation of September 1967—A Month of Continued Record Warmth in the West, Coolness in the East, and Frequent Tropical Activity," *Monthly Weather Review*, vol. 95, No. 12, Dec. 1967, pp. 956–966.
2. Environmental Data Service, ESSA, *Weekly Weather and Crop Bulletin*, vol. 54, Nos. 41–45, Oct. 9, 16, 23, 30, and Nov. 6, 1967, pp. 1–8.

CORRECTION NOTICE

Vol. 95, No. 9, pp. 615–626: Data in tables 3–6 inadvertently repeat the data in table 2. We regret the inconvenience this error may have caused users of these data. Corrected tables 3–6 are presented on the following pages (pp. 63–74).